Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (previously presented): A method for ion implanting a species into a layer of a workpiece in a chamber, said method comprising:

placing said workpiece in a processing zone of said chamber bounded by a chamber side wall and a chamber ceiling facing said workpiece and between a pair of ports of said chamber near generally opposite sides of said processing zone and connected together by a conduit external of said chamber;

introducing into said chamber a process gas comprising the species to be implanted;

generating from said process gas a plasma current and causing said plasma current to oscillate in a circulatory reentrant path comprising said conduit and said processing zone.

Claim 2 (previously presented): The method of Claim 1 further comprising:

attracting ions of said species from said plasma to said layer.

Claim 3 (previously presented): The method of Claim 2 wherein the step of attracting ions comprises:

applying a bias to said workpiece, and setting said bias to a level corresponding to a desired depth in said layer to which said element is to be implanted.

Claim 4 (previously presented): The method of Claim 2 wherein the step of attracting ions comprises:

applying a bias voltage to said workpiece, and setting said bias voltage to a level corresponding to a desired depth in said layer to which said element is to be implanted.

Claim 5 (original): The method of Claim 1 wherein the step of generating a plasma current comprises coupling RF source power into said conduit, whereby to cause said plasma current to oscillate at a frequency of said RF source power.

Claim 6 (previously presented): The method of Claim 3 wherein said layer comprises a semiconductor material, and said species to be implanted comprises a dopant impurity that promotes one of a p-type or n-type conductivity in said semiconductor material, and wherein said desired depth to which said element is to be implanted corresponds to a desired p-n junction depth.

Claim 7 (original): The method of Claim 6 wherein said gas comprises a chemical combination of said dopant impurity and another element.

Claim 8 (original): The method of Claim 7 wherein said gas comprises a fluoride of said dopant impurity.

Claim 9 (original): The method of Claim 7 wherein said gas comprises a hydride of said dopant impurity.

Claim 10 (previously presented): The method of Claim 7 wherein said gas further comprises a co-implant ion bombardment element which removes from a top surface of said layer a material that tends to accumulate during implantation of said dopant impurity.

Claim 11 (previously presented): The method of Claim 1 wherein said layer comprises a semiconductor crystal which is to be implanted with a dopant impurity element, and wherein said species comprises a pre-implant ion bombardment species that creates damage in said semiconductor crystal for amorphizing said surface layer.

Claim 12 (previously presented): The method of Claim 1 wherein said surface layer comprises a dielectric thin film, and wherein said species comprises a surface-enhancement species which enhances a characteristic of said dielectric thin film layer upon implantation and substitution.

Claim 13 (original): The method of Claim 12 wherein said characteristic is the electrical behavior of said dielectric thin film.

Claim 14 (original): The method of Claim 12 wherein said dielectric thin film comprises an oxide of a semiconductor element, and said species comprises a non-oxygen element to be substituted for oxygen atoms in said dielectric thin film.

Claim 15 (original): The method of Claim 1 wherein the step of placing said workpiece on said workpiece support is preceded by:

introducing a passivation process gas containing passivation-forming chemical species;

forming a passivation layer on interior surfaces of said chamber by generating from said passivation gas a plasma current and causing said plasma current to oscillate in a circulatory reentrant path comprising said conduit and said processing zone.

Claim 16 (original): The method of Claim 15 wherein said passivation gas comprises one of a hydride, a fluoride or an oxide of a semiconductor element.

Claim 17 (original): The method of Claim 16 wherein said passivation gas comprises a chemical species containing carbon and fluorine.

Claim 18 (original): The method of Claim 15 wherein the step of generating a plasma current from said process gas is followed by:

removing said process gas from said chamber;

removing said workpiece from said chamber;

introducing a passivation layer-removing gas into said chamber;

generating from said passivation layer-removing gas, a plasma current and causing said plasma current to oscillate in a circulatory reentrant path comprising said conduit and said processing zone, so as to remove said passivation layer from said interior surfaces of said chamber.

Claim 19 (original): The method of Claim 18 further comprising heating said interior surfaces of said chamber during the removal of said passivation layer.

Claim 20 (original): The method of Claim 18 wherein said passivation layer-removing gas comprises a fluorine-containing gas.

Claim 21 (original): The method of Claim 18 wherein said passivation layer-removing gas comprises a hydrogen-containing gas.

Claim 22 (original): The method of Claim 1 wherein the step of introducing said process gas is preceded by:

pre-cleaning said wafer.

Claim 23 (original): The method of Claim 22 wherein the step of precleaning said wafer comprises removing an accumulated layer therefrom.

Claim 24 (original): The method of Claim 23 wherein the step of removing comprises removing an oxide layer from said workpiece.

Claim 25 (original): The method of Claim 24 wherein the step of removing an oxide layer comprises etching said oxide layer.

Claim 26 (previously presented): The method of Claim 1 wherein the step of generating a plasma current from said process gas is followed by:

heating said layer of said workpiece to an anneal temperature sufficiently high to cause atoms of the species implanted in said layer to be substituted into atomic sites in a crystal lattice of said layer.

Claim 27 (previously presented): The method of Claim 26 wherein said layer is masked by a photolithographic layer defining a pattern of ion implantation, and wherein the step of heating said surface is preceded by:

removing said photolithographic layer.

Claim 28 (original): The method of Claim 27 wherein the step of removing said photolithographic layer is carried out in a

pyrolization chamber.

Claim 29 (previously presented): The method of Claim 26 wherein the step of heating said layer is carried out after removing said workpiece from said chamber and placing it in an anneal chamber.

Claim 30 (currently amended): The method of Claim ~~6~~ 10 wherein said process gas is one of (a) hydride of said dopant species or (b) a fluoride of said ~~dopoant~~ dopant species, and said ion bombardment element comprises one of: Helium, Hydrogen, a semiconductor element of the type including Silicon, Germanium, Carbon, a fluoride of a semiconductor element of the type including fluorides of Silicon, Germanium, Carbon.

Claim 31 (original): The method of Claim 18 wherein said passivation layer-removing gas comprises NF3.

Claim 32 (original): The method of Claim 6 wherein said semiconductor material is silicon and said dopant impurity is boron.

Claim 33 (original): The method of Claim 6 wherein said semiconductor element is silicon and said dopant impurity is phosphorus.

Clam 34 (original): The method of Claim 6 wherein said semiconductor element is silicon and said dopant impurity is arsenic.

Claim 35 (original): The method of Claim 14 wherein said semiconductor element comprises one of silicon or germanium.

Claim 36 (previously presented): The method of Claim 1 wherein:

said layer comprises plural dielectric gates formed over an underlying layer having horizontal and non-horizontal surfaces;

the step of applying bias power comprises selecting a level of said bias power promotive of a sufficiently collisional plasma sheath over said workpiece to produce a significant fraction of ions impacting said layer at trajectories other than orthogonal to said layer whereby to implant ions in said horizontal and non-horizontal surfaces of said layer.

Claim 37 (previously presented): The method of Claim 6 wherein said layer comprises a crystal lattice and wherein the step of generating a plasma current from said process gas is preceded by:

introducing into said chamber an amorphizing gas comprising an ion bombardment species;

generating from said amorphizing gas a plasma current and causing said plasma current to oscillate in a circulatory reentrant path comprising said conduit and said processing zone;

applying bias power to said workpiece support to attract ions of said ion bombardment species from said plasma toward said layer whereby said ions cause damage in said crystal lattice to amorphize said crystal lattice.

Claim 38 (original): The method of Claim 37 wherein said ion bombardment species comprises a semiconductive species.

Claim 39 (original): The method of Claim 38 wherein said ion bombardment species comprises one of silicon or germanium.

Claim 40 (previously presented): The method of Claim 7

wherein said process gas further comprises an ion bombardment species for co-implantation with said dopant impurity in said layer.

Claim 41 (previously presented): The method of Claim 40 wherein ions of said ion bombardment species are implanted in said layer to cause crystal lattice damage for amorphizing said surface layer during implantation of said dopant impurity in said layer.

Claim 42 (original): The method of Claim 41 wherein said ion bombardment species comprises a semiconductor species.

Claim 43 (original): The method of Claim 42 wherein said semiconductor species comprises one of silicon or germanium.

Claim 44 (original): The method of Claim 1 wherein said bias comprises RF bias power.

Claim 45 (original): The method of Claim 1 wherein said bias comprises D.C. bias power.

Claim 46 (original): The method of Claim 44 further comprising pulse modulating said RF bias power.

Claim 47 (original): The method of Claim 45 further comprising pulse modulating said D.C. bias power.

Claim 48 (original): The method of Claim 46 further comprising pulse modulating said RF source power.

Claim 49 (original): The method of Claim 48 further comprising maintaining a relation between the pulse modulating of

said RF bias power and the pulse modulating of said RF source power that is one of:

(a) push-pull;

(b) in-synchronism;

(c) symmetrical;

(d) non-symmetrical.

Claim 50 (original): The method of Claim 47 further comprising pulse modulating said RF source power.

Claim 51 (original): The method of Claim 48 further comprising maintaining a relation between the pulse modulating of said D.C. bias power and the pulse modulating of said RF source power that is one of:

(a) push-pull;

(b) in-synchronism;

(c) symmetrical;

(d) non-symmetrical.

Claim 52 (original): The method of Claim 1 wherein the step of applying said bias power comprises applying a single burst of said bias power to said workpiece support.

Claim 53 (original): The method of Claim 52 wherein said single burst has a duration corresponding to a desired implant dosage.

Claim 54 (original): The method of Claim 53 further comprising:

sensing when a voltage measured near said workpiece support reaches a threshold corresponding to the desired implant depth in response to applying said bias power;

triggering a clock in response to said sensing step,

and terminating said bias power when said clock reaches said duration.

Claim 55 (original): The method of Claim 54 further comprising controlling said bias power so as to produce a bias voltage near said workpiece support at least nearly equal to said threshold.

Claim 56 (original): The method of Claim 44 wherein said RF bias power has a bias frequency that is sufficiently low for ions in a plasma sheath near said workpiece to follow electric field oscillations across said sheath at said bias frequency.

Claim 57 (original): The method of Claim 56 wherein said bias frequency is sufficiently high so that RF voltage drops across dielectric layers on said workpiece do not exceed a predetermined fraction of the RF bias voltage applied to said workpiece support.

Claim 58 (original): The method of Claim 57 wherein said predetermined fraction corresponds to about 10%.

Claim 59 (original): The method of Claim 44 wherein said RF bias power has a bias frequency between 10 kHz and 10 MHz.

Claim 60 (original): The method of Claim 44 wherein said RF bias power has a bias frequency between 50 kHz and 5 MHz.

Claim 61 (original): The method of Claim 44 wherein said RF bias power has a bias frequency between 100 kHz and 3 MHz.

Claim 62 (original): The method of Claim 44 wherein said RF bias power has a bias frequency of about 2 MHz to within about

5%.

Claim 63 (original): The reactor of Claim 1 wherein said species to be implanted comprises a first atomic element, said process gas further comprising:

a second atomic element in chemical combination with said first atomic element.

Claim 64 (previously presented): The method of Claim 63 wherein said surface layer of said workpiece is a semiconductor material and said first atomic element is an n-type or p-type conductivity dopant impurity with respect to said semiconductor material.

Claim 65 (original): The method of Claim 64 wherein said second atomic element comprises a semiconductor element.

Claim 66 (previously presented): The method of Claim 65 wherein said second atomic element and said semiconductor material of said surface layer are the same atomic element.

Claim 67 (previously presented): The method of Claim 64 wherein said second atomic element is an element having a greater tendency than said first atomic element following ion implantation to diffuse out of said surface layer upon heating of said surface layer.

Claim 68 (original): The method of Claim 64 wherein said second atomic element comprises one of hydrogen and fluorine.

Claim 69 (original): The method of Claim 64 wherein the chemical combination of said first and second atomic species comprises a first molecular species, said process gas further

comprising a second molecular species.

Claim 70 (original): The method of Claim 69 wherein said second molecular species comprises one of: (a) hydrogen gas, (b) fluorine-containing gas.

Claim 71 (original): The method of Claim 68 wherein said first molecular species comprises a fluoride of said dopant impurity and said second molecular species comprises a hydride of said dopant impurity.

Claim 72 (original): The method of Claim 71 wherein said process gas further comprises a third molecular species.

Claim 73 (original): The method of Claim 72 wherein said third molecular species comprises at least one of (a) hydrogen-containing gas, (b) fluorine-containing gas, (c) an inert gas.

Claim 74 (original): The method of Claim 1 further comprising:

providing a cleaning plasma species source reactor;

prior to the step of introducing said workpiece, producing a plasma in said cleaning species source reactor from chamber cleaning species precursor gases to produce chamber cleaning plasma species;

furnishing said chamber cleaning plasma species from said cleaning species source reactor into said plasma immersion ion implantation reactor so as to clean interior surfaces of said plasma reactor, and then removing said chamber-cleaning plasma species from said plasma immersion ion implantation reactor.

Claim 75 (original): The method of Claim 43 wherein said chamber cleaning precursor gases comprise a fluorine-containing

species and said chamber cleaning plasma species comprise fluorine-containing radicals.

Claim 76 (original): The method of claim 74 wherein said chamber cleaning precursor gases comprise a hydrogen-containing species and said chamber cleaning plasma species comprise hydrogen-containing radicals.

Claim 77 (original): The method of Claim 1 further comprising:

providing an optical metrology chamber;

obtaining a measurement of ion implantation in a workpiece previously processed in said plasma immersion ion implantation reactor;

adjusting said magnitude of said bias in accordance with said measurement.

Claim 78 (previously presented): The method of Claim 1 further comprising:

providing an ion beam implantation apparatus;

placing said workpiece in said ion beam implantation apparatus and implanting a second species in said layer.

Claim 79 (previously presented): The method of Claim 78 wherein said layer is a semiconductor material, and said first and second species are dopant impurities of opposite conductivity types relative to said semiconductor material.

Claim 80 (original): The method of Claim 79 further comprising:

masking devices on said workpiece of one conductivity type and exposing devices of an opposite conductivity type during ion implantation of said first species in said plasma immersion

type during ion implantation of said second species in said second plasma immersion ion implantation reactor.

Claim 86 (original): The method of Claim 1 further comprising:

providing a wet clean chamber;

and wherein the step of generating said plasma current is followed by placing said workpiece in said wet clean chamber.

Claim 87 (previously presented): The method of Claim 1 further comprising:

providing a second plasma immersion ion implantation reactor;

placing said workpiece in said second plasma immersion ion implantation reactor and implanting a second species in said layer.

Claim 88 (original): The method of Claim 87 wherein said layer is a semiconductor material, and said first and second species are dopant impurities of opposite conductivity types relative to said semiconductor material.

Claim 89 (original): The method of Claim 88 further comprising:

masking devices on said workpiece of one conductivity type and exposing devices of an opposite conductivity type during ion implantation of said first species in said plasma immersion ion implantation reactor;

masking devices on said workpiece of said opposite conductivity type and exposing devices of the one conductivity

ion implantation reactor;

masking devices on said workpiece of said opposite conductivity type and exposing devices of the one conductivity type during ion implantation of said second species in said ion beam implantation apparatus.

Claim 81 (original): The method of Claim 80 wherein said first species is of a lower mass than said second species.

Claim 82 (original): The method of Claim 80 wherein said first species comprises boron and said second species comprises arsenic.

Claim 83 (previously presented): The method of Claim 1 further comprising:

providing an anneal chamber;

after the step of generating a plasma current, removing said workpiece from said plasma immersion ion implantation reactor and placing it in said anneal chamber, and heating said layer sufficiently to cause at least some of the species ion implanted in said surface layer to be substituted into crystal lattice atomic sites of said layer.

Claim 84 (original): The method of Claim 83 wherein the step of heating comprises a dynamic surface anneal process.

Claim 85 (original): The method of Claim 1 further comprising:

providing a photoresist strip chamber;

the step generating a plasma current is followed by placing said workpiece in said photoresist strip chamber and removing photoresist from said workpiece.